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Full Length Research Article

EFFECT OF LOCATION AND TIME OF INTRODUCING COWPEA ON YIELD OF COWPEA IN A MAIZE/COWPEA INTERCROP IN SOUTHERN KADUNA, KADUNA STATE, NORTH- WESTERN NIGERIA

*Bayei, Joseph Dauda and Banta, Ayuba La'ah

Department of Agricultural Economics and Extension, Faculty of Agriculture, Kaduna State University, Kafanchan Campus.

*Corresponding Author's Email Address: joseph.bayei@kasu.edu.ng/ bayeijoseph@gmail.com

ABSTRACT
Field experiments were conducted during the 2019 rainy season at the Kaduna State University Teaching and Research Farm, Kafanchan (latitude 9.5833 °N and longitude 8.2869 °E) located in Jema'a Local Government area and Madakiya, (latitude 9.6899°N and longitude 8.2869°E) located in Zango Kataf Local Government area, all in Southern Kaduna, Kaduna State, North- Western Nigeria. These locations are at an altitude of about 636m above sea level, to investigate the yield of cowpea as influenced by time of introducing it to maize in Southern Kaduna the treatments consisted of four times of introducing cowpea (8,9,10 and 11 weeks after sowing maize (WASM))and two locations(Kafanchan and Madakiya). laid out in a randomized complete block design (RCBD) with four replications, Results revealed that of all the parameters measured, location significantly influenced number of pods/plant of cowpea only. However, location and the interaction between time of introduction of cowpea and location did significantly affect the growth and yield of cowpea. It is therefore recommended that Cowpea should be introduced in maize/cowpea intercrop in the 8th and 9TH WASM in Madakiya and 10th and 11th WASM in Kafanchan as these locations and timings gave significantly higher yields than others.

Keywords: Productivity, cowpea, maize, intercrop, influenced, Southern Kaduna

INTRODUCTION

Cowpea (*Vigna unguiculata* (L)) is an important grain legume in the dry savanna of the tropics covering 12.5 million hectares with annual production of about 3.3 million tons (FAO, 2005). It is adapted to a wide range of soils ranging from infertile or acid to saline and alkaline soils. The crop requires generally two to three months of evenly distributed rainfall and a dry period for drying of pods. It is drought tolerant like all legumes (Steiner, 1982). Cowpea requires a temperature of not less than 20 °C with an optimum range of 18- 32°C for good growth and development. Cowpea is just gaining prominence and gradually graduating to being a major factor among crops that are grown in the zone. Nigeria is said to be one of the world's largest producers of cowpea with an average production of 2.92 million tons, followed by Niger with 1.10 million tons (FAO, 2012). In spite of the economic importance of cowpea, its production is considered risky by many farmers in the Southern part of Kaduna State, where it is highly susceptible to numerous pests and diseases as well as climatic variabilities (Andrew, 2006). Several cowpea varieties have been developed for the Nigerian savannas but little information exists on the performance of these varieties when relay-intercropped with maize and in different locations. Maize (*Zea mays* L.) however, is perhaps the most completely domesticated of all field crops (Singh et al. 2003) and is known to be a major staple in the farming schedules of most Southern Kaduna farmers. The crop is one of the most important cereals in the dry savannahs of Africa, especially West Africa (Singh et al. 2011). In fact, it is one of the most important cereal crops in Nigeria where over 150 million people subsist on it. Several studies have been carried out on yield from intercrops; most of these studies have shown that sole crops yield higher than intercropped ones. Adduced reasons for this observation include: competition for scarce resources like nutrients, sunlight and water. Also there is the ease of efficient utilization of inputs for improved agronomic practices. Despite these facts, intercropping systems continue to manifest in the cropping patterns of peasant farmers in Nigeria. The advantages attributed to mix as opposed to sole cropping include but are not limited to risk aversion, extensive and intensive use of resources (land and labor), greater return per unit land area, reduction of pest and diseases and the possible improvement of soil fertility.

Cereals/legume mixtures, especially maize/cowpea are a common practice in the northern guinea savanna ecological zone of Nigeria (Ofuso-Amin and Limbani, 2007). In terms of land use, growing crops in mixed stands is regarded as more productive than growing them separately. One of the justifications is the belief that some of the nitrogen fixed by the legume would be transferred to the associated crops.. The yield advantages of legume- cereal intercropping system over sole have been reported (Pal *et 'al,* 1993). However, results demonstrated varietal differences in the cowpea response to method of planting. Ibrahim (2008) observed that maize grain yield was not affected by the intercropped cowpea, but cowpea grain yield was reduced by 19% in the sole crop.
The knowledge of the productivity of cowpea and maize in intercrop in any agro ecological zone is pertinent to food security policies for farming families. Since most of the varieties are selected in sole cropping systems, there is need to evaluate their performance in intercropping systems which is very common in Nigeria.
Several studies have been carried out on intercropping of crops; must results from such studies have shown that sole cropping gave high yield compared to intercropping. Reasons for low yields from intercropping obviously are: competition for scarce nutrients, shading sunlight and water. Yield from maize/sorghum showed no significant difference. Intercropping of sorghum and leguminous

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plant, *Cajanus cajan* showed significant difference in the yield of sorghum because of shading Singh *et. al.* (2003). They recommended relay intercrop system for improved yield in areas with bi-modal rainfall. They found out too, that delay introduction of cowpea in sorghum/Centro mixture gave high yields for sorghum and Centro. Also that intercropping of cereal and leguminous plants reduce the effect of the Witch-weed striga in a field known for striga infestation to an almost zero effect. The study revealed that introducing cowpea at 9WASS (weeks after sowing sorghum) gave good result because at this time, sorghum has attained maximum physiological growth and at this time too when sorghum will be physiologically matured for harvesting, cowpea will be in its active growth and development, so there is less competition for water and nutrients and when sorghum is harvested and the residue cleared, it will give cowpea space to harness the energy from the sunlight for maximum photosynthesis production as sole crop and hence the improve yield. Mehdi *et al.* (2009) reported a grain yield decrease when maize population was increased in maize-cowpea intercrops. Muoneke *et al*. (2012) found out in one study that time of introducing cowpea to maize-cowpea intercrop had a significant effect on dry matter and nodules/plant of cowpea sown four weeks after sowing maize. Brintha (2010) opined that intercropping offered several advantages to small scale farmers, that by intercropping with appropriate crops at an appropriate sowing date, these may benefit from improved soil fertility, increased productivity and reduce risk of total crop failure. Ibrahim (2008) reported that cowpea plant height, days to 50% flowering, leaf area and leaf area indices were not significantly affected by intercropping in 1997 and 1998. That the mean number of pod/plant, pod weight and seed yield of cowpea varieties were significantly different in maize intercrop. Intercropping according to him also affected plant height, leaf area and leaf area indices of cowpea significantly. The beneficial effects of maize-cowpea intercropping according to Toungos *et al*.(2018), has not been fully exploited. In another study, it was found out that time of introducing cowpea in maize significantly affected both the growth and yield of cowpea (Muoneke *et al*., 20012). They opined that correct combination of intercropping, suitable variety and sowing date that will enhance growth and yield of the two components in intercropping are very necessary. Time of introducing cowpea to maize-cowpea intercrop significantly affected both the growth and yield of cowpea.

MATERIALS AND METHODS

Field experiments were conducted during the wet season (May-October) of 2019 at the Kaduna State University Teaching and Research Farm, Kafanchan (9.5833^{o}N and longitude 8.2907'E), in Jema'a Local Government Area and Madakiya (latitude 9.6899^{o}N and longitude 8.2869^{0}E), in Zangon Kataf Local Government Area of Southern Kaduna, Kaduna State, North Western Nigeria. The two locations enjoy approximately five to seven months (April - October) of uni-modal rainfall with the peak period in August. The treatments consisted of four times of introducing cowpea (8, 9, 10 and 11 weeks after sowing maize (WASM) and two locations (Kafanchan and Madakiya) laid out in a randomized complete block design (RCBD) with four replications.

The maize variety used was the tropical open pollinated, drought resistant and early maturing maize widely cultivated in the areas. The cowpea variety (black eye), is a commercial seeded cultivar that is commonly grown in Southern Kaduna and widely accepted in the Nigerian markets (Tripplet, 2002). The experimental plots were ploughed and harrowed twice without ridging. The plots measured 20m x 18m (360m^2) were used. The seeds were treated with Apron plus dust shortly before sowing to control soil borne pests and pathogens. Maize and cowpea were planted in rows at two seeds/stand at an intra-row spacing of 25cm and inter-row spacing of 75cm to maintain 53,333 plants per hectare. Planting of maize was carried out on the 6th June, 2019 and cowpea was then relay intercropped on 1st 8th, 15th and 22nd, August, 2019. The cowpea plants were sprayed with Dolphin E.C. at 60ml/10 litres of water to control thrips. Grain yield determination of cowpea was obtained by randomly harvesting ten cowpea plants from two middle rows to determine the number of pods/plant, number of primary and secondary branches etc. Data were subjected to analysis of variance to determine the magnitude of the main and interaction effects of the treatments. Duncan multiple range test (DMRT) was used to separate the meanss of significant treatments. The analysis was done using statistix 10.0 statistical package (1985).

RESULTS

Location did not show any significant effect on days to flowering, however, time of introduction of cowpea did (Table 1). There was significant interaction (P≤0.05) between location and time of introduction of cowpea on days to flowering (Table 1). Cowpea sown at 8WASM in Kafanchan location took the longest number of days to flower, which was statistically similar to all other interactions except the cowpea sown at 11 WASM in both locations (Table 2). Days to maturity was not signifycantly affected by location, however, there was a significant effect of time of introduction on days to maturity of cowpea (Table 1). The interaction between location and time of introduction had a highly significant (P≤0.01) effect on days to maturity (Table 1). The longest time of maturity (99.3days) was recorded at 8WASM in Kafanchan (Table 3) although, this was at par with the interaction between 8WASM at Madakiya, 9 WASM at Kafanchan and 9WASM at Madakiya but had significantly longer days to maturity than all other interactions (Table 3).

Table 1: Effect of location and time of introduction of cowpea in maize on yield and growth parameters of cowpea

Treatment	Days to flowering	Days to maturity	Pods/ plant	Pod length (cm)	No. of prim branches	No. of sec branches	100 seed wt (gm)	Yield/ plot (gm)
Location								
Kafanchan	62.8	93.5	14.9b	16.6	6.90	5.63	40.1	583.1
Madakiya	61.9	92.3	23.2a	15.3	7.25	6.40	39.4	543.6
SE(±)	1.74	1.69	1.20	0.66	0.42	0.53	2.40	33.49
Time of introduction								
8 WASM	65.9a	98.5a	25.6a	19.0a	6.13b	4.88b	41.1	587.1
9WASM	64.3a	94.6ab	23.1a	15.4b	7.63ab	6.63a	40.6	576.6
10 WASM	62.5a	90.6bc	18.4b	14.8b	7.50a	5.88ab	40.4	579.0
11 WASM	56.9b	87.9c	9.0c	14.6b	7.00ab	6.63a	36.9	510.8
SE(±)	2.47	2.39	1.70	0.93	0.60	0.74	3.40	47.36
Interaction (AxB)	*	***	****	****	****	****	****	****

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize; * significant; *** and **** highly significant

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Table 2: Effect of interaction between Location and Time of introduction on Days to Flowering of cowpea

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	66.5a	64.5ab	63.0a-c	57.3bc
Madakiya	65.3a	64.0ab	62.0a-c	56.5c
SE(±)		3.50		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize

Table 3: Effect of interaction between location and time of introduction on days to 50% maturity

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	99.3a	95.0a-c	91.3b-d	88.5cd
Madakiya	97.8ab	94.3a-d	90.0cd	87.3d
SE(±)		3.37		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize

Location had a significant effect on number of pods/plant with Madakiya (23.2) recording more pods/plant than Kafanchan (Table 1). Time of introduction of cowpea also had a significant effect on number of pods/plant with the cowpea introduced in the 8th and 9th WASM having comparable number of pods/plant, which were significantly higher than the cowpea introduced in the10th and 11th WASM (Table 1). The interaction between location and time of introduction of cowpea had a highly significant (P≤0.01) effect on number of pods/plant (Table 1). The highest number of pods/plant (38.0) was recorded at 9WASM at Madakiya (Table 4) which was at par with that recorded at 8WASM in Madakiya (Table 4) but significantly more than all other interactions.

Table 4: Effect of interaction between location and time of introduction on pods/plant of cowpea

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	16.3c	8.3d	26.8b	8.3d
Madakiya	35.0a	38.0a	10.0d	9.8d
SE(±)		2.40		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize.

Pod length was not significantly affected by location; however, time of introduction did (Table 1). The cowpea introduced at 8WASM produced pods that were significantly longer than the other treatments. The interaction between location and time of introduction had a highly significant (P≤0.01) effect on pod length (Table 1). Mean comparison (Table 5) showed that the longest pod length (23.5) was recorded in 9WASM at Madakiya. This was similar with the interaction between 8WASM at Madakiya and 10 and 11 WASM at Kafanchan (Table 5) but significantly more (lenghth) than all other interactions.

Table 5: Effect of interaction between location and time of introduction on pod length of cowpea

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	15.3b	7.3c	21.3a	22.5a
Madakiya	22.8a	23.5a	8.3c	6.8c
SE(±)		1.32		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize

Location did not show any significant effect on number of primary branches recorded but time of introduction did (Table 1). The interaction between location and time of introducing cowpea had a highly significant (P≤0.01) effect on number of primary branches. The highest number of primary branches (10.5) for mean comparison was recorded at 9 WASM in Madakiya (Table 6). This was statistically similar with 10 and 11WASM at Kafanchan but significantly higher than all other interactions.

Table 6: Effect of interaction between location numbers of primary branches/plant of cowpea

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	4.3c	4.8c	9.3ab	9.3ab
Madakiya	8.0b	10.5a	5.8c	4.8c
SE(±)		0.85		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize.

On number of secondary branches/plant, the result shows that location had no significant effect on it. Time of introduction of cowpea, however, had a significant statistical effect on number of secondary branches (Table 1). The interaction between location and time of introduction had a highly significant (P≤0.01) effect on

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number of secondary branches with the highest number of secondary branches (8,0) at Madakiya at 9WASM. This was statistically similar with 10 WASM at Kafanchan and 11 WASM at both Kafanchan and Madakiya, as well as 8WASM at Madakiya (Table 7), but higher than the other interactions.

Table 7: Effect of interaction between location and time of introduction on number of secondary branches of cowpea.

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	3.5d	5.3b-d	7.0ab	6.8a-c
Madakiya	6.3a-c	8.0a	4.8cd	6.5a-c
SE(±)		1.05		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize.

Location did not show any significant effect on 100 seed weight neither did time of introduction of cowpea (Table 1). However, the interaction between location and time of introduction of cowpea had a highly significant (P≤0.01) effect on 100 seed weight. The highest seed weight recorded (48.8) was at 8 WASM at Madakiya, and this was statistically at par with 9 WASM at Madakiya as well as 10 and 11 WASM at Kafanchan. These had statistically higher 100 seed weight compared with others which were all statistically similar to each other (Table 8).

Table 8: Effect of interaction between location and time of introduction on 100 seed weight of cowpea

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	33.5b	33.5b	47.5a	46.0a
Madakiya	48.8a	47.8a	33.3b	27.8b
SE(±)		4.77		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize

Location and time of introduction of cowpea did not have any significant effect on yield of cowpea (Table 1). The interaction between location and time of introduction of cowpea, however, had a significant effect on yield. The highest yield recorded (823) was in cowpea introduced at 10 WASM in Kafanchan (Table 9). This was statistically the same with the interaction between 8 and 9 WASM in Madakiya and 11 WASM in Kafanchan but significantly higher than other interactions.

Table 9: Effect of interaction between location and time of introduction on plot yield of cowpea.

Location	Time of introduction of cowpea (WASM)			
	8	9	10	11
Kafanchan	373.8b	350.8b	823.0a	785.0a
Madakiya	800.5a	802.5a	335.0b	236.5b
SE(±)		66.98		

Means followed by the same letters are not significantly different at 5% level of probability according to the Duncan Multiple Range Test (DMRT).

WASM = weeks after sowing maize.

DISCUSSION

The growth parameters of cowpea in intercrop with maize in Kafanchan and Madakiya in 2019 rainy season indicated that location did not have any significant effect on the investigated cowpea parameters, however, time of introduction of cowpea in maize had significant effects on growth parameters and pod yield of cowpea. This could be explained by the fact that the two locations and indeed most other locations in Southern Kaduna share similar environmental characteristics since they all lie in the Southern Guinea savannah. The interaction between location and time of introduction of cowpea did influence these parameters (Table 1). This contradicts the work of Ibrahim (2008) who reported in a study to investigate yield performance of some cowpea varieties under sole and intercropping with maize at Bauchi, that cowpea plant height, days to 50% flowering, leaf area and leaf area indices were not significantly affected by intercropping in 1997 and 1998. The finding in this work that time of introducing cowpea in mixture of maize/cowpea intercrop significantly affected the growth and yield of cowpea supports an earlier report by Muoneke *et al.(2002)* where it was found that, time of introducing cowpea in maize significantly affected both the growth and yield of cowpea.

Recommendation

Based on the findings of this study, it is recommended that:
Cowpea should be introduced in maize/cowpea intercrop in the 8th and 9TH WASM in Madakiya and 10th and 11th WASM in Kafanchan as these locations and timings gave significantly higher yields than others.

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